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POPULATION¹

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THREE is scarcely a subject in whose depths one may escape the problem of population. It pervades history and sociology, it penetrates ethics and philosophy, it influences science and the arts. This is because it is solely in man's own interest, his food and protection, his love and happiness, that he founds social and political systems, establishes codes of morals, and otherwise busies himself going to and fro upon the earth. If there be an unvoiced criticism that these are mere platitudes founded on man's domination of the world, and that a diversity of phases in the problem of population, as usually delimited, does not necessarily follow, it is not well-founded. The *problem* of population takes form when it is realized what a large number of these vital interests of mankind are antagonistic to each other, are even mutually exclusive. And as a problem not one of these numerous ramifications may profitably be excluded.

In spite of the catholicity of the subject, it has had definite consideration by only two classes of thinkers, theologians and economists. The theologians have discussed it with their habitual effusiveness, but their examination has been superficial. For them, mundane happiness has a very low order of magnitude. It is a distasteful matter, unworthy of the spiritually minded. Such progress as has been made, and it should not be minimized, has resulted from the analysis of the economists. And I say this mindful that the man who made the greatest original contribution to the subject was entitled to place the word Reverend before his name; for he wrote as an economist, not as a theologian.

I submit, however, that there should be no such monopoly. Such a momentous and difficult problem should not be the sole property either of priest or politician, of economist or social worker. I do not suggest its preemption by the biologist; yet by its nature the question is fundamentally biological, and if the biologists do not interest themselves in it, it can not receive the attention it deserves.

¹ Address of the retiring President, delivered at the thirty-seventh annual meeting of The American Society of Naturalists held at Princeton, New Jersey, December 30, 1919.

The problem of population is not new. Like all general questions it has interested mankind ever since there has been some modicum of civilization. But, with that scholasticism characteristic of the majority of publicists of all times, it seldom has seemed necessary to base their statements, theories, or laws, upon concrete facts. One obtains little reward other than cynical amusement in following out its history, from the *Lex Papia et Poppaea*,² enacted for the purpose of encouraging marriage and legitimate fecundity, by the efforts of two old bachelor consuls in the year 10 A.D., to the analogous contemporary propaganda of our erstwhile bachelor colleague Popenoe,³ from the naïve teachings of the early Christian fathers, to the modern headline that "Mrs. Blindly Helpful warns of birth decline,"—probably in the same awed tone that Little Orphan Annie whispered, "the goblins 'ill git you." But even as the development of the doctrine of evolution is comparatively uninteresting until one reaches Lamarck and Darwin, the theories of population have little intellectual standing until the time of Franklin⁴ (1751) and Malthus⁵ (1798).

Franklin's chief contribution to the subject was a short essay entitled "Observations concerning the Increase of Mankind and the Peopling of Countries." In it the dependence of population increase or decrease on food, commerce, type of government and conditions of labor, were succinctly and accurately stated. Malthus acknowledged his indebtedness to Franklin; but the fate of Franklin's essay as compared to Malthus's treatise was as those of Wallace and of Darwin on Natural Selection, the logic was good but the basis of material fact was small.

Malthus, on the other hand, delved successfully for facts and found their meaning. In spite of bitter criticism his work is accepted to-day by leading economists with little change. The only difficulty is that the world is inclined to blunder along without heeding Malthus's warning. It sits gaily at its present feast oblivious of the *mene tekel* on the wall. How many of our leading biologists, even, have read the "Essay on Population"? They know it gave to Darwin his long-sought concrete cause of organic evolution, Natural Selection, but in general can they

² Strangeland, C. E., "Premalthusian Doctrines of Population," *Studies in History, Economics and Public Law*, Vol. 21, No. 3, pp. 1-356, 1904.

³ Popenoe, P. and Johnson, R. H., "Applied Eugenics," New York, Macmillan, 1918, pp. 459.

⁴ Franklin, B., *Miscellany*. (1751.)

⁵ Malthus, J. R., "An Essay on Population," 3 vol. Georgetown, Milligan, 1809. First American from third London edition.

do more than speak vaguely of a geometrically increasing population pressing upon an arithmetically increasing food supply? If the scholar thus casually passes by a fundamental cause of past, present and future social unrest, can one justly call to court the harebrained Bolshevik for his fallacious doctrines, or rail against legislators, who, true to their primary principle of holding firmly to their jobs, pass resolutions to investigate the high cost of living or the relations of labor and capital, with the same aplomb as they would undertake to investigate the law of gravitation could such a procedure further their political fortunes?

Malthus's work went through many editions. In some particulars the first imprint was more pessimistic than the later revisions. Perhaps if the author were alive to-day he would return to his first impressions; but since the purpose of this paper is to look into the facts as they affect the present and the immediate future, I shall epitomize his mature conclusions as given in the third edition.

The object of his inquiry was to examine the causes impeding the happiness of mankind, and to speculate on the probability of their removal. The chief cause of distress and misery he attributed to the constant tendency of man, in common with the lower animals, to increase beyond the means of subsistence. Irrational animals, he states, are powerfully impelled to increase their species freely, deterred by no doubts about providing for their offspring; and the results of this freedom are afterwards repressed by want of room and nourishment. Mankind, impelled to increase by the same instinct, is somewhat checked by reason; but nevertheless the tendency is such that the increase of mankind actually does press upon the means of subsistence to such an extent that various forms of misery, or the fear of misery, are the direct result.

The ultimate check to population is thus a want of food which necessarily results from the different ratios according to which population and food increase.

The immediate check may be stated to consist of all those customs, and all those diseases, which seem to be generated by a scarcity of the means of subsistence; and all those causes, independent of this scarcity, whether of a moral or physical nature, which tend prematurely to weaken and destroy the human frame.

These obstacles to increase, he maintained, were resolvable into moral restraint,—to which one may to-day add artificial family limitation,—vice, and misery. To state the matter a little differently, increase in population is the chief cause of

misery in so far as that misery is caused by the struggle for existence. Under this head he named "unwholesome occupations, severe labor, extreme poverty, undernourishment of children, great towns, excesses of all kinds, the whole train of common diseases, wars, plagues and famine."

One may without exaggeration add materially to this list, for all of man's activities are resolvable into a struggle for existence and a struggle for perpetuation, and it is the antagonism of these two instincts that leads to all the trouble.

To my mind, the Reverend Doctor proved his case very neatly in the three volumes of his work. Not only that, but he discovered two principles as corollaries to this main thesis, which are particularly important at the present day. The first is to the effect that emigration relieves population but temporarily, owing to the increased birth rate of the remaining population resulting from a release of the economic pressure. The second is that the lower classes of a population tend to replace the upper classes,—a natural conclusion following from the fact that that part of the population which takes no thought of the future has the highest birth rate.

Nevertheless, in spite of this thorough and scholarly attempt to place before the public logical conclusions on this great problem, induced from concrete facts, in spite of later analysis and acceptance by every economist of note, there is still a hue and cry for population. European countries, crowded to the utmost, appoint commissions to inquire into their declining birth rate, and to take steps to increase it. Tempestuous people in the public eye thunder forth *dicta* about the subject, though blindly ignorant of the facts and making no pretense of learning them. Even those who pass for scientists and might be expected to look into the subject, seem obsessed with the same idea. Witness a paper⁶ delivered a short time ago by the statistician of the Metropolitan Life Insurance Company at a meeting of the American Association for Advancement of Science, and afterwards spread broadcast as a part of *The Congressional Record*. It is difficult to account for such narrowness of view, superficiality of logic, and general inability to grasp the broad problem, as is exhibited in this paper. If these are the reactions of those from whom some basis of knowledge might reasonably be demanded, what is to be expected from the man on the street who is entranced as with a toy by the mere idea of bigness—a

⁶ Dublin, L. I., "The Significance of the Declining Birth Rate," *Science*, N. S., 47: 201-210, 1918. See also reply with same title by Ellen Hayes, *Science*, N. S., 50: 533-536, 1919.

big country, lots of people—let them live as best they may. But enough of this; let us examine the facts on the subject as we face them to-day.

In the time of Malthus, the world could still be considered as a collection of more or less isolated geographical entities. Succeeding the original development of subraces through real isolation, there had been waves of migration with resulting intermixtures of peoples, it is true; but at that time, a short 100 years ago, there remained a condition of geographical separation which has now been swept away. The world war brought home to us the illusiveness of distance. In considering the question before us from the broadest point of view, the whole globe must be treated as a unit.

How fast the population of the earth has increased in the past is an unknown quantity, and will remain unknown. An estimate of the present population or of its natural increase is not accurate by any means, but is more than a random conjecture. From the returns of the Registrar General of England, the Census reports of the various civilized countries, the Stateman's Year Book, and the opinions of several travellers in Africa and the Orient, I estimate that there are at present 1,700 million people. A careful review of the factors involved leads me to believe that the probable error is not greater than \pm 40 million. Again, the annual natural increase estimated country by country, disregarding the effect of the war, totals not less than 14 million or more than 16 million. This is an average rate of about 9 per thousand. To show that this estimate is conservative, I may say that a letter from the Office of the United States Census rates the annual increase of population in the world at approximately 25 million.

Consider a moment what these figures mean. Not long ago we were asked to speed production, to save, to waste nothing, that Belgium might be fed and clothed. We did this and more, and we may well be proud of a difficult task efficiently accomplished. But, have we realized, can we realize, that 2 Belgiums are added to the world's population each year? And all must be fed,—though perhaps some need not be clothed.

Segregating this increase by races as accurately as one may, shows that the white race is increasing much more rapidly than either the yellow or the black. China's 300 million population is practically stationary; India and the South Sea Islands are increasing spasmodically, but probably not at a greater rate than 8 per thousand. Japan, on the other hand, has a natural

increase of over 13 per thousand; and the theoretical curve fitted to the crude birth rate is *rising*, though the crude death rate is stationary. The blacks are increasing rapidly only in this country, where the natural increase is now about 11 per thousand, and in the West Indies. In Africa they are increasing but slowly. In some parts they are actually decreasing, and it is doubtful if they reach the figure for the United States even in the richest sections of the continent. The white race is the race on the road to numerical domination. With the exception of France, few white peoples are increasing at a less rate than 10 per thousand. The countries of eastern Europe, Russia, Rumania, Bulgaria and Serbia, with tremendous birth rates, from 40 to 50 per thousand, are increasing at a rate of from 17 to 19 per thousand, while Australia and New Zealand, with low birth rates, from 26 to 28 per thousand, are multiplying at nearly the same speed, due to their low death rates.

It is natural to ask how the Great War affected these estimates. No precise answer to the question can be given, because it is just possible that the after effects of this war will be unlike the after effects of previous wars, in that the birth rate will continue to be depressed below the pre-war figures. Personally, I do not believe this will be the case. I believe we may read the future in the past, and that the birth rates will take such upward trends in the war stricken countries that in a very few years they will readily fit projections of the pre-war curves. In other words, I believe it to be a fair prediction that so far as general gross natural increase of population is concerned, the curve when plotted from 1900 to 1950, if that be some day possible, will show only a temporary deflection for the years 1914 to 1919. The tide of population is not kept back by the flimsy barrier of war, it is but baffled for the moment.

Naturally, if one looks at the subject more minutely, he cannot deny the great influence of the war upon the countries primarily involved. The reports are conflicting, but various official estimates place the direct losses at between 10 and 12 million. The indirect losses are hardly more than half as much, —perhaps much less. Indeed if one could correct for lessened death rates due to army training, the total would be materially diminished. It may be doubted, therefore, whether all losses, direct and indirect, attributable to the war, are over 18 million. And I may say that this statement is not made haphazard, but after due consideration of the data from the statistical divisions of several of our own and other governmental agencies. Compare this, then, with the effects of the pandemic of influenza in

which not less than 20 million people are thought to have lost their lives. Numerically, both of these figures are terrible, staggering, incomprehensible; yet on a percentage basis they are trifling when compared with the wars and plagues which swept Europe and Asia in former times, and from which they recovered with astonishing rapidity.

Let us turn for a moment to the potential loss due to the decrease in the birth rate. An estimate in 1917,⁷ based on cities in Germany comprising about one sixth of the population, showed that the German birth rate had dropped about 10 per thousand. If we assume this to be correct for warring Europe plus Turkey in Asia, three years potential loss is approximately 8,500,000.⁸ This figure allows Russia in Europe but one third the loss of the others, for the very good reason that the Russian manner of living is such that a loss of 3 or 4 per thousand more nearly represents the facts, and excludes the United Kingdom where the depression was slight. This again is a great potential loss, but is it not small compared with the total population of the countries involved, and will it not be made up as it has at the close of all other wars by a temporary supernormal birth rate? Furthermore, in central Europe it was found that the war conditions actually made for a lower infant mortality, probably because of a greater frequency of enforced breast feeding; and the actuality of the potential loss is not wholly what it seems to be.

These facts are given for the purpose of showing that in spite of wars, notwithstanding plagues and pestilences, the world goes merrily on obeying to the letter the biblical injunction, "increase and multiply." But I hear the question, is this going to continue? Is there not a generally decreasing birth rate? Yes, this is true. In most of the civilized countries of the world the birth rate is slowly but steadily decreasing. The result, however, is not what many would have us believe. The inter-nation correlation between the birth rate and death rate is high. In general, where the birth rate is high, the death rate is likewise high.⁹ Where the birth rate is low, the death rate is

⁷ Vital Statistics in Germany. Taken from *Veröffentl. d. k. Gesundheitsamtes* (41: 1917), by War Office. Issued in Medical Supplement, Review of the Foreign Press.

⁸ Cf. Mallet, Sir Bernard, "Vital Statistics as Affected by the War," *Jour. Roy. Stat. Soc.*, 81: 1-36, 1918.

⁹ Cf. Drysdale, C. V., "The Small Family System," New York, Huebsch, 1917, pp. 196. Also "The Declining Birth Rate: its Causes and Effects." Rpt. National Birth Rate Commission (Great Britain). New York, Dutton, no date (preface dated 1916), pp. 450.

low. Australia, New Zealand and Holland with low birth rates have tremendous rates of natural increase, rates much higher than many other countries with very much larger birth rates. There is but one outstanding exception to this rule—France. Though France reduced her births, she failed to reduce her deaths as fast as might reasonably be expected in a country with her standard of culture. Having reached a point where there is practically no natural increase, therefore, her death rate more nearly measures the absolute length of life of her inhabitants, and for that reason seems abnormally high. Were the birth rate of France to take a sudden rise, there would be the apparent paradox of a fall in the death rate due to an increasing population. Nevertheless France stands alone in this. Other countries from which we have statistics are still increasing, and in them the positive correlation between the birth and death rate holds; although in saying this we make no claim as to the relation for intra-nation correlation on a time basis, for the simple reason that it has not been adequately studied. It is a fair prediction, however, to say that owing to the steadily increasing development of medicine and of general sanitation, the decrease in the birth rate will have no great effect on the natural increase in the world for many years to come. In fact it would not be surprising if during the next 50 or 100 years the excess of births over deaths should go up rather than down in many countries.

What is to become of this flood of people? The international situation at present is this. China is stationary in population, —a high birth rate (if we may believe reports), and a high death rate. With a permanent system of agriculture she feeds herself. Northern Asia, Central Asia and even India can support a few more people. Australia and New Zealand are increasing at a rate which their possibilities in the way of food production can stand for only a short time. Europe, as a whole, is already over-populated. England is in the least desirable condition, with the countries of northern Europe running her a close second. By great efforts Europe can support its present population without extreme hardship, but the efforts must be sustained and efficient. There remains then, Africa and South America, as colonization centers,—the United States we leave for separate consideration. These places should be able to support a large number of people. True, large portions are tropical, and the white man has not been a particularly successful occupant of the tropics; nevertheless one may predict, without undue optimism, that these difficulties will be conquered, and

that these lands will repeat the history of North America. There will be emigration from Europe, and perhaps from Asia; there will be a birth release in the new lands; and they will teem with people. And let us make no mistake here. If science makes this development possible, the time when Africa and South America are filled to the practical limits of their food production is no dim and distant future. If the rate of increase actually existent during the nineteenth century in the United States should obtain, within the span of life of the grandchildren of persons now living, these countries will contain over a billion inhabitants.

Long before this eventuality, the struggle for existence in those portions of the world at present more densely populated will be something beyond the imagination of those of us who have lived in a time of plenty. Each geographical unit must then of necessity produce its food. It will be impossible for a country to maintain a position such as that of England. Excess population supported by commerce will be a thing of the past. There will be commerce, of course, but exportation of food in quantity will not longer be tolerated.

To present this matter in a way which will bring home the economic and biological consequences of population pressure, let us consider it in some detail as it affects the United States. We have taken the census thirteen times,¹⁰ 120 years,—not a long period as even history is measured. In 1790 the population was 4 million; in 1910 it was 92 million. In 1920 we may expect to have somewhere near 110 million people. In 120 years, the country had increased in population 23 times; in 130 years, it presumably will have increased 27 times. More minutely, of the 92 million returned by the enumerators in 1910, 82 million were white and 10 million yellow and black,—chiefly the latter. But of the 82 million white, only 68 million were native white, over 13 million being foreign born. If we look a little closer, we find that only about 49 million were native whites of native parentage,—32 million being either foreign born or of foreign or mixed parentage. Thus in 1910 only 53.8 per cent. of the population were native whites whose parents had been born in this country, though from 1820 the total immigration had been less than 28 million.

With this chronicle of the past as a basis, one may visualize the future, provided the causes of increase remain the same.

¹⁰ All U. S. population figures from publications of the U. S. Bureau Census. Quoted figures on other countries from Reports of the Registrar General of England.

In 1891 Pritchett¹¹ found that the population curve of the United States could be represented by a parabola with the equation $P = A + Bt + Ct^2 + Dt^3 + \dots$, where P represents the population and t the time from an assumed epoch. How well the projection of this curve has fitted for a short period is shown by the actual and the computed figures for the last three census years. In 1890 they were almost identical; in 1900 there was an excess of nearly a million and a half, and in 1910 an excess of over two million and a half in favor of the computation.

This is a rather good fit, all things considered; but, the fact that the actual population is already lagging behind the predicted population shows that the causes operating in the earlier history of the country have now been modified. The computations of 386 million for the year 2000 and 1,113 million for the year 2100, therefore, are much too high. Nevertheless, these are short periods, 80 and 180 years, respectively, and the tendency toward an almost unbelievable increase is strikingly shown. Let us keep in mind the *possibility* of taking care of 300 million people before all of our children have ceased their struggle for existence, and of supporting some 700 million who will compete with our grandchildren, while we turn our attention to the resources of the country as they exist to-day.

I know I shall be termed a preacher of calamities, but the facts admit of but one conclusion: the law of diminishing returns is even now in operation in this comparatively new country thought to be supplied with inexhaustible riches. This is the result of my own somewhat extensive investigation. It is the result of the accurate scholarly study of Thompson,¹²—the only economist, as far as I have been able to discover, who has had the courage to face the subject in a thoroughly scientific manner.

This age has been called the Age of Steel, an apt trade name for our present type of civilization. Nevertheless this period, like all ages past, and all times to come, is one of Agriculture. Civilization, like an army, marches on its stomach. The present and potential food supply is what interests us most. It is true we could show that in spite of the abundant supply of mineral wealth within our boundaries, all is not as well as might be.

¹¹ Pritchett, H. S., "A Formula for Predicting the Population of the United States," Amer. Stat. Assn. Quar. Pub., N. S. 14, Vol. 2: 278-286, 1891. This formula may not be the most precise one possible, but it serves our present purpose.

¹² Thompson, W. S., "Population: A Study in Malthusianism." Privately printed, Ann Arbor, 1915, pp. 216.

Our coal supply is being dissipated. Nearly a sixth¹³ of our visible supply of anthracite has been mined within the limits of one generation. But 15,000 tons per capita of bituminous coal still remain untouched,—presumably enough for about 5 centuries with the present per capita consumption. Our petroleum reserve is speeding on its way at a still greater pace. Forty per cent. of the visible supply is gone, and merely at the present rate of consumption there is only enough left for some twenty-odd years.

If, as our mining experts claim, the total supply of these, our two main sources of energy, has been mapped properly, it would seem that our Steel Age is on the road to senility. To a Babylonian returned to look over the prospects, it would probably appear as a transient phase unworthy of particular notice. Perhaps matters are not so bad as they are painted, however. Our utilization of water power is still very limited, and in the more distant future we can look to the moon for our energy requirements. We shall harness the tides. In the case of agriculture, I am not so sanguine.

The sower, the tiller, the reaper, go their ways with the same changeless routine they have taken since the dawn of civilization. No fairy godmother has appeared to aid our most essential art; and the story of the past gives us reason to be skeptical of the future. In a way agriculture has become more efficient. Chemistry, physics and biology in their applied branches have given us a more definite knowledge of cause and effect, and have provided for a greater return per unit of man power. But he who makes two blades of grass grow where but one grew before must be prepared to pay the price in a lesser number of blades to come after. Novel methods of culture, more efficient machinery, new and better yielding varieties, are but means of exploiting a limited reserve of soil fertility at a higher rate.

It is curious what false ideas in regard to agricultural possibilities are held by so many people. Not long ago I asked a well-trained business man how much more land could be brought into cultivation. His off-hand estimate was between 400 and 600 per cent. Now the whole land area of the Untied States is only 1,903 million acres;¹⁴ and 47 per cent. is now included in farms, although only about 55 per cent. of the area of these farms is improved. There remains 1,023 million acres, as a

¹³ Gilbert, C. G. and Pogue, J. E., "The Energy Resources of the United States: a Field for Reconstruction," U. S. Nat. Mus. Bull., 102: 1-165, 1919.

¹⁴ Cf. Thompson, W. S., *l. c.*

reserve supply. Of this, 468 million acres is arid land having an annual precipitation of less than 15 inches, 200 million acres must be preserved as forest lands, 75 million acres is swamp with perhaps 40 million acres permanently unusable, and 41 million acres is already in cities, roads and railroads. There is then a grand total of 749 million acres which must be withheld from agricultural use permanently, without allowing for urban and transportation increase. When this is subtracted, the 274 million acres left does not loom so large. There is a parcel of 40 million acres to be added, however, when all irrigation projects possible under the present system of construction are made available, making a total of 314 million acres. This calculation shows that we have been extravagant in our optimism. After the expenditure of vast sums, after the completion of tremendous tasks of engineering, we can add barely 35 per cent. to our present farm area.

We may catch at the straw in sight, and point out that only 55 per cent. of farm lands are improved, and that therefore when all available land is improved, 170 per cent. of our present area will be added. But this straw is loose, as a little consideration shows. The unimproved land of to-day remains uncultivated because the net returns for farm produce are not high enough to warrant its cultivation. Bluntly, it is too poor to be farmed until the price of food goes higher. Not only is this true, but it should also be emphasized that many farms in the older parts of our country, which once produced a profit, have so deteriorated after a lone century of cultivation that they are now either tilled at a loss or are abandoned.

It would be foolish to maintain that this country can not support a much larger population. This is not the economic question before us. The population will continue to increase for years to come, though more and more slowly as discomfort and want become more prevalent. My point is that the reserve farm land is less productive than the improved land, that the fertility of the soils now being tilled is decreasing, that the law of diminishing returns is now in active operation. If these are the facts, and the statements are amply supported, a continuous increase in the food cost of living must go hand-in-hand with an increase in population, although there may be a temporary after-war downward trend if production is sustained and the water forced out of our inflated currency. There will be more people, but there will be a more strenuous struggle for existence proportionate to the increase.

What is the reason for asserting that diminishing returns now show in agriculture? There are various ways of throwing light on the question, but data from two sources are sufficient. Elaborate chemical, physical and plot culture investigations of various soils¹⁵ have been made by the Agricultural Experiment Stations of Illinois, Ohio, Pennsylvania and Minnesota, and less extensive experiments have been carried on in other states. One who takes the trouble to study the published reports of these researches with care is fully repaid. They prove beyond question that the farm soils of the United States are by no means of unlimited fertility. The three essential elements of fertility, so-called, potassium, phosphorus and nitrogen are present in such small quantities that the natural production curve of various types of soil under particular systems of cropping can be estimated with a fair degree of accuracy. And in most cases it is not centuries but decades before continuous cropping shows decreasing returns, no matter what the rotation.

Fortunately there is a comparatively large supply of potash in most soils, and there is nitrogen to be obtained from the air by the proper use of legumes or by electrical methods; but the phosphorus content, generally speaking, is so low that it soon becomes deficient if not replaced by artificial fertilizers, for nearly 4,000 million pounds of phosphoric acid¹⁶ are removed annually by the grain crops alone,—nearly 20 pounds per acre. Fortunately again, the element commonly limiting the fertility of the soil may be supplied for a time from the large phosphate beds¹⁷ of South Carolina, Florida, Tennessee and the Northwest, which contain over half of the world's supply, estimated by Hopkins at 500 million tons. The matter of prime importance, however, is not the *possibility* of keeping up crop returns for a considerable period when all available means are utilized. It is, that natural cropping by the present system is depleting all soils rapidly, and that millions of acres have already reached the point where their present productiveness can only be kept up by increasing amounts of artificial fertilizers. Much of our natural agricultural wealth has been used, with no charge made for it in the production costs. This is bad bookkeeping. No charge for depreciation means bankruptcy in any business.

¹⁵ Hopkins, C. G., "Soil Fertility and Permanent Agriculture," Boston, Ginn, 1910, pp. 653.

¹⁶ Hopkins, C. G., *l. c.*

¹⁷ Cf. Wyatt, Francis, "The Phosphates of America." New York, Sci. Pub. Co., 1892, 4th ed., pp. 187.

Now that the fertilizer industry is increasing by leaps and bounds, and farming with the use of artificial manures must compete with new land farming, we can see more clearly what the ledger sheet of the future must show. Absolute costs per unit of man power, and per monetary unit, are mounting and will continue to mount, because of the diminishing returns which such a system entails. Furthermore, there will come a time, a time not so very distant, when the current agricultural system must be replaced. A more efficient system of saving plant nutrients similar to that of China and certain European countries must be installed. The elaborate scheme of waste evolved by our sanitary engineers will have to be discarded.

Perhaps there are those, however, who deny the truth of the current theories of soil fertility. Such denials have been made, though without the support of quantitative data. Nevertheless, be the theories of soil fertility what they may, the experiments on continuous cropping are facts. There is a decrease in *natural* productiveness with all known methods of continuous cropping, which is so rapid it may well alarm those who look toward the future.

Let us examine data on this subject from a second source. They are perhaps still more convincing. We see continually in the various reports of government agencies, how much the crops of the country for a definite year exceed those of a previous year or term of years in acreage, production, and value; yet it is of no particular importance that our production of crops or of food-animals is increasing. Paper wealth is cold comfort. What we wish to know is whether with improved machinery, new methods, and better varieties, our agriculture is keeping pace with our population.

The per cent. of actual increase in population in the decade 1900 to 1910 was 21. The per cent. of increase in farm lands during the same period was 4.8. But this does not necessarily mean a great deal. To obtain more pertinent data I have plotted the *per capita* production of meat animals, and of acreages and production of the chief agricultural crops from 1870 to 1916.¹⁸ In order to obtain trustworthy figures, the enumerations of animals for the census years only have been used, while the production figures are the ten-year averages centering on the census years. The last point is the average for the years 1915, 1916 and 1917. The graphs are very interesting and

¹⁸ The figures upon which these calculations are based, have been taken from the Year books of the U. S. Dept. of Agriculture.

illuminating, but this is not the place to consider them in detail. The gross results are as follows. The peak of swine production, .951, was reached in 1880. In 1910 it was .633, and in 1916, .667. After various fluctuations sheep production reached .809 in 1900, but in 1916 was only .480. Milch cows have remained rather more constant, but the curve shows a downward trend since 1890. Other beef cattle, perhaps the chief meat supply, have dropped markedly from a high point of .666 in 1900 to .399 in 1916.

The vast grazing lands of the early days are gone and with them low priced meat has passed. Does one need any other reason for the rise in meat price-rates up to the year 1915?

Let us pass now to the per capita acreage of the great cereals and potatoes. Corn remained the same from 1880 to 1890, about 1.16, and has dropped slowly ever since. Wheat reached a peak of .67 in 1880, and has steadily gone down to .52. Oats was the same in 1916 as in 1890, but was lower *ad interim*. Rye and potatoes have remained rather constant, though the tendency is downward. The barley acreage has risen through the demands of the liquor interests, but may be expected to drop with the incoming of prohibition. Thus in the pre-war period from 1870, the acreage of three great cereals, corn, wheat and oats, is not a matter of congratulation, though production through the increased use of fertilizers, better varieties and more intense cultivation has been sustained.

The production history for corn in the decades from 1870 taking for the last point the average of the years 1915, 1916 and 1917, is 23.38, 29.43, 27.28, 27.90, 29.72, and 28.61 bushels. As a whole, then, corn production has just about kept pace with population. Wheat, the basis of national life, follows nearly the same course. The figures 6.01, 8.24, 7.24, 7.60, 7.23 and 7.59. Oats have risen sharply. The figures are 6.63, 8.65, 10.41, 10.49, 11.17, 14.39.

These figures, considering them from all angles, are not a cause for present pessimism. The increased production of 1918 and 1919, due to the stimulation of war prices, shows what may be done by intensive methods even with our present system of agriculture. Nevertheless, I ask you to note that as a whole our food production per capita from about 1880 or 1890 to the war period has slightly declined. And this is in face of a tremendous increase in the use of fertilizers, a widespread propaganda for better methods of cultivation which was not without its results, a constant influx of improved machinery,

and a continuous production of new and better yielding varieties. There is but one conclusion. Diminishing returns in agriculture *are operating*, and with a continuously and rapidly increasing population they will become more and more in evidence.

The arguments that have been used concerning diminishing returns in agriculture are not negated by the fact that the United States is still exporting large quantities of food. Since the people of the United States do not at present eat all the food produced, many will say that all is well. This does not follow. The improvident individual may feast before he wants. The prodigal heir may have a high time before the reckoning comes. The business on the verge of bankruptcy may be running at the peak of production. No one denies that the productivity of the United States is at present beyond her needs. No one denies that this production may be increased very considerably. We do maintain that capital is being dissipated to show these results, that returns are lessening to such an extent that the food cost of living—barring the war disturbance—is bound to rise, and that certain portions of the country actually do feel the pressure.

It may be replied that decreasing returns in agriculture will be offset by increasing returns in non-agricultural industry. But, as Thompson has shown, it is not at all certain that manufacture presents increasing returns. It is but recently that cost accounting has taken into consideration the case of the workman, and it has not yet included the cost of maintaining our great city industrial systems with their streets, bridges and railways, their schools and hospitals, their banks and libraries, their bonded indebtedness. With these increased charges, what would be the balance sheet? The very fact of the immense bond flotations of our political units show that we are building upon the insecure assumption that the present social system is sound and permanent. Unless increasing returns for the country as a whole are in sight, our house is built upon sands. Let us give these matters their proper place when dealing with panaceas for social unrest. There can be no value in prescriptions which leave untouched the fundamental causes.

If pressure upon the means of subsistence is beginning to be felt in this relatively new country, if misery and suffering due to overcrowding is approaching—and who can face the facts and continue to doubt—what a dire prospect exists for

the older countries of the world.¹⁹ And a sad feature of the case is the fact that though there be a continuous emigration to those portions of the world where unexploited natural wealth still remains, but slight temporary relief will be afforded the countries from which the emigrants go. *Long before the sparsely populated lands are filled, in the next half century in such prosperous countries as our own, there must be a shift of population from the cities to the farms.* Coincident with this industrial change there must be a simplification and probably a lowering in what we are pleased to call the standard of living. Technical industry can not take the burden of this shift and still continue to furnish the whole of the people with the comforts and luxuries they have come to deem necessary. Contemplation of this fact is all that is necessary to show that at the same time there will be a continued lowering of the birth rate. The relation between these matters is not kept from the people. Their theories on the subject may be hazy, but direct pressure on existence is a great teacher. The birth rate will continue to go down, and immigration will be greatly restricted if not prohibited. Broadly speaking, this is a result not to be deplored. Why then is so much time, ink and paper used in decrying the declining birth rate? There is one real reason, but it is not the one acknowledged by greater population propagandists.

Economically the position of the French people in 1914, with a very slowly increasing population, was extraordinarily good. Thrift and industry had placed them in the fore-front of the nations of the world, and there was relatively little pressure upon the means of subsistence. They feared two things: first, immigration of peoples with lower standards of living and greater rates of natural increase, with resulting replacement of the native French; second, attack from the east. Both fears had a real basis as we know, and Leagues of Nations or of

¹⁹ One of my colleagues has made the off-hand criticism that these conclusions do not hold because no allowance has been made for the "immense possibilities in the way of utilizing sea food." This criticism well illustrates the ease of refuting a statistical argument by using a statement which has no basis of fact. In the first place, the sea-food industry of the world is of little import as a factor in feeding the world's population. Making all due allowance for possible understatement in the statistical returns, the value of the sea-food production of the world is *less* than that of the production of poultry and eggs in the United States. In the second place, diminishing returns in this industry are indicated by the fact that the increase in capital employed during the last 20 years is very much greater than the increase of the returns in product.

Notions will not abate them. These apprehensions will always be bogies of small nations. The odd thing is that so many statesmen should encourage actual misery from over population to alleviate a fear of possible misery through aggression.

In a country such as the United States the second fear is groundless. With a proper preparation for war, an attack on the United States should not be considered seriously. Mere masses of people are not a menace as they once were, as the Germans and Russians have demonstrated. And we are big enough to take care of ourselves. The other fear is something more definite, but few give it any attention. The unacknowledged reason why the politician wants more people is to satisfy his longing for greater power, the hidden desire of too many capitalists is for cheap labor. The real objection to a declining birth rate is that it is always selective.

The selective birth rate in the United States is a subject on which much has been written, but on which there is little accurate information. The vital statistics of various states are meagre and rather untrustworthy. In fact even at the last report (1916),²⁰ the registration area included only about one third of the whole population. The crude birth rate for that year was reported as 24.8 and the crude death rate 14.7, leaving a natural increase of 10.1 per thousand; but the figures probably do not represent the facts. Neither death rates nor birth rates are reported in full, but the deficiency in registration of births is undoubtedly greater than that of deaths. It would not be a surprising matter if the real natural increase in the United States as a whole is about 11.5.

The negro birth rate²¹ is put at 22.8 and the death rate at 24.4. Obviously these figures can not be accepted at their face value. Not only are the vital statistics registered for negroes known to be less accurate than those for whites; but no part of the real "black belt," where the negro is in his best environment, lies within the registration area. The figures are largely from cities where there is an extensive negro population, places in which numerous factors tend to lower the natural increase from that attained in the "black belt" even though the economic condition based on per capita wealth may seem higher. The census figures for 1910 give some idea of the discrepancy.

²⁰ Birth statistics for the registration area of the United States (1916). Second Annual Report. U. S. Bur. Census, 1918, pp. 96.

²¹ The Negro Population in the United States, 1790-1915. U. S. Bur. Census, 1918, pp. 844.

In the previous decade the negroes increased 993,769, 11.2 per cent., and this may be taken as largely from natural increase, since there was an increase of only 20,003 foreign born, and this figure must be diminished by about 45 per cent. to allow for emigration. During the same period the whites increased by 22.3 per cent. The proportion of negroes in the population as a whole is decreasing, therefore, yet one can not help but feel that if all the data were at hand, the natural increase of the whites and the negroes would be found to be about the same. If venereal diseases are ever stamped out among them, and a reasonable degree of sanitation instituted, there is scarcely a doubt but that they will tend to supplant the whites, for the whites have kept their numerical superiority largely through immigration and a better knowledge of hygiene. Thus, since there were nearly 10 million negroes in continental United States in 1910, the color problem is not the negligible matter some of our northern sociologists would have us think.

Another fact which should be regarded seriously is that the mixed bloods are increasing much more rapidly than the pure blacks. There were nearly twice as many mixed bloods in 1910 as in 1890. In 1890 the mulattoes formed 15.2 per cent. of the negro population, in 1910 they represented 20.9 per cent. With the white blood comes greater intelligence, a lower death rate, and in all probability a higher birth rate. In time segregation and recombination of traits will result in a considerable number of people with negro blood who will pass for white.

It seems hardly necessary to point out the undesirability of this situation. The negro is a happy-go-lucky child, naturally expansive under simple conditions; oppressed by the restrictions of civilization, and unable to assume the white man's burdens. He accepts his limitations; indeed, he is rather glad to have them. Only when there is white blood in his veins does he cry out against the supposed injustice of his condition. White germplasm in a negro complex spurns its hopeless situation, as Humphrey²² notes. Yet the result of such a wide racial intermixture is a mediocrity; which, owing to the numerous gametic differences linked and coupled in an infinite complexity of ways, will tend to remain a mediocrity till the end of time.

Concerning the potentialities of our white "Melting Pot," one is likely to say too much or too little. As a mere matter of statistics the country seems to be progressing fairly well. There is a somewhat greater proportion of foreign than of

²² Humphrey, S. K., "Mankind," New York, Scribner, 1917, pp. 223.

native paupers, but that might be expected without great discredit to the former. In 1910 there were .88 per thousand native and 1.57 per thousand foreign-born prisoners and juvenile delinquents,²³ but in all probability the sins of the good American citizen did not find him out as often as might be desired. At the same period there were 1.69 per thousand natives and 4.05 per thousand foreigners in institutions for the insane. No doubt the terrific whirl of American life drove some of these newcomers mad, for the proportion is rather different in institutions for the feeble-minded. The ratio there per thousand is, native 2.65, native of native parentage 1.70, native of foreign parentage 2.86, and foreign born, .93.²⁴

In acquiring some slight knowledge of letters the foreigners coming to our shores have done well. In our native white population born of native parents 3.7 per cent. were unable to read and write in 1910, but although 12.7 per cent. of the foreign born were in the same predicament, hardly one tenth as many natives born of foreign or of mixed foreign and native parents are to be so classified.²⁵

In spite of this somewhat unexpected showing from our recent emigrants, however, there are reasons for serious misgivings, misgivings sufficient to warrant us advocating such restrictions as to practically prohibit immigration for a period of time that will at least permit us to consider the subject in all its aspects. The examinations in the selective draft, the radical labor troubles now in full fruit, the Bolshevik propaganda, have shown how refractory are some of the ores in the melting pot and how poorly our fires have been tended.

We have developed too rapidly, and are experiencing acute growing pains in various portions of the anatomy of our body politic. It is troublesome and should be attended to, but it is not extremely serious. If we continue as in the past, we shall suffer indeed. We must come to realize that if we make the most of our grand heritage of democratic ideals left by the fathers of colonial days, we must change our tactics.

The point, it seems to me, is this. Our political legacy, our folkways, our Americanism, is North European, Northern Aryan, Nordic. Whatever one wishes to call it, its origin is

²³ Prisoners and juvenile delinquents, 1910. U. S. Bur. Census, Bull. 121, 1914, pp. 130.

²⁴ Insane and feeble-minded in institutions. U. S. Bur. Census, 1914, pp. 217.

²⁵ Illiteracy in the United States. U. S. Bur. Census, Bull. 26, 1905, pp. 54. Also 13th Census of U. S.

not in doubt. Our great men in all lines—statesmen, warriors, writers, scientists, inventors—came so largely from this ethnic mixture that if they are excluded but little is left. Some one once said: Take from France her hundred great ones, and where is France? We may paraphrase it thus: Take from Columbia her Anglo-Saxon sons, she is bereaved indeed. And is she not being dispossessed of her Anglo-Saxon stock? The birth rate of our foreign population, coming so largely now from eastern and southern Europe, is so much greater than that of the Anglo-Saxons that within a century the latter will be but a fraction of the whole.

It may be that the various ethnic mixtures recently acquired will do their full share toward contributing to the progress of civilization. There are many, however, who feel justified in maintaining that if immigration had been restricted in the middle of the nineteenth century, the country would be better off physically, morally, mentally and economically. There would be almost as many people within its limits, for the superior types of the early days would not have been forced to the wall by the avalanche of progeny begotten by the horde of aliens. Given the time these matters may right themselves, but it should not be forgotten that it is just such waves of immigration that overturn civilizations before there is time for readjustment.

We are entering such a period. We must fight for time, or accept an overturn of the present social order. No doubt it is desirable to have social changes; it is suicidal to allow a sudden economic chaos. Among biologists a defense of private property, free enterprise, and a competition which does not interfere with social order, is unnecessary. These things must be, in order to bring out the fittest to survive. At the same time there must be a regulation of the degree of social warfare or a reversion to savagery will result. People are much alike. The capitalist takes everything when he has the chance; the workman hopes to take everything when he is able. Obviously this natural law promotes progress; but in society even as in nature, the most rapid progress comes when the selective action is directed along certain channels and restricted to particular ends. The great effort, then, must be to direct it properly. Denying its existence is of little avail.

What is the answer? As I see it, it is this: First a severe restriction of immigration; second, education; third, equitable readjustment in many of our economic customs; last, but by no means least, rational marriage selection, a somewhat increased

birth rate in families of high civic value, and among the rank and file a restriction of births commensurate with the family resources and the mother's strength.

Economically we can not afford a high birth rate, but it should be cut in the proper place. If this be done, it means a fall in the death rate, in the disease rate, in the proportion of misery and poverty. It means less child labor and illiteracy, less prostitution and venereal diseases. It means a healthy home life, larger production, greater economical freedom and therefore happiness. Anything else is merely reducing the fit to the level of the unfit.

If we have the brains, the energy and the courage to put through such a program there is some hope of escaping the whirlpool into which we are drifting. The ingredients in the melting pot are not all bad by any means, and—one may be thankful for it—they do not form an amalgam. Each and every ethnic contribution carries some hereditary factors making for a good or even a great individual. The result of the interbreeding of the next century will on the whole be mediocrities, as it has been in the past, but recombination will give here and there the individual with the characters that make for genius and progress will be assured. If we do not open our eyes on this problem of population, however, there will be troubles in the future which will make those of the present seem like the tempests of a teapot.